Evaluation of Impacts on Surface Water Quality Associated with a Release of Fly Ash at TVA's Kingston Fossil Plant

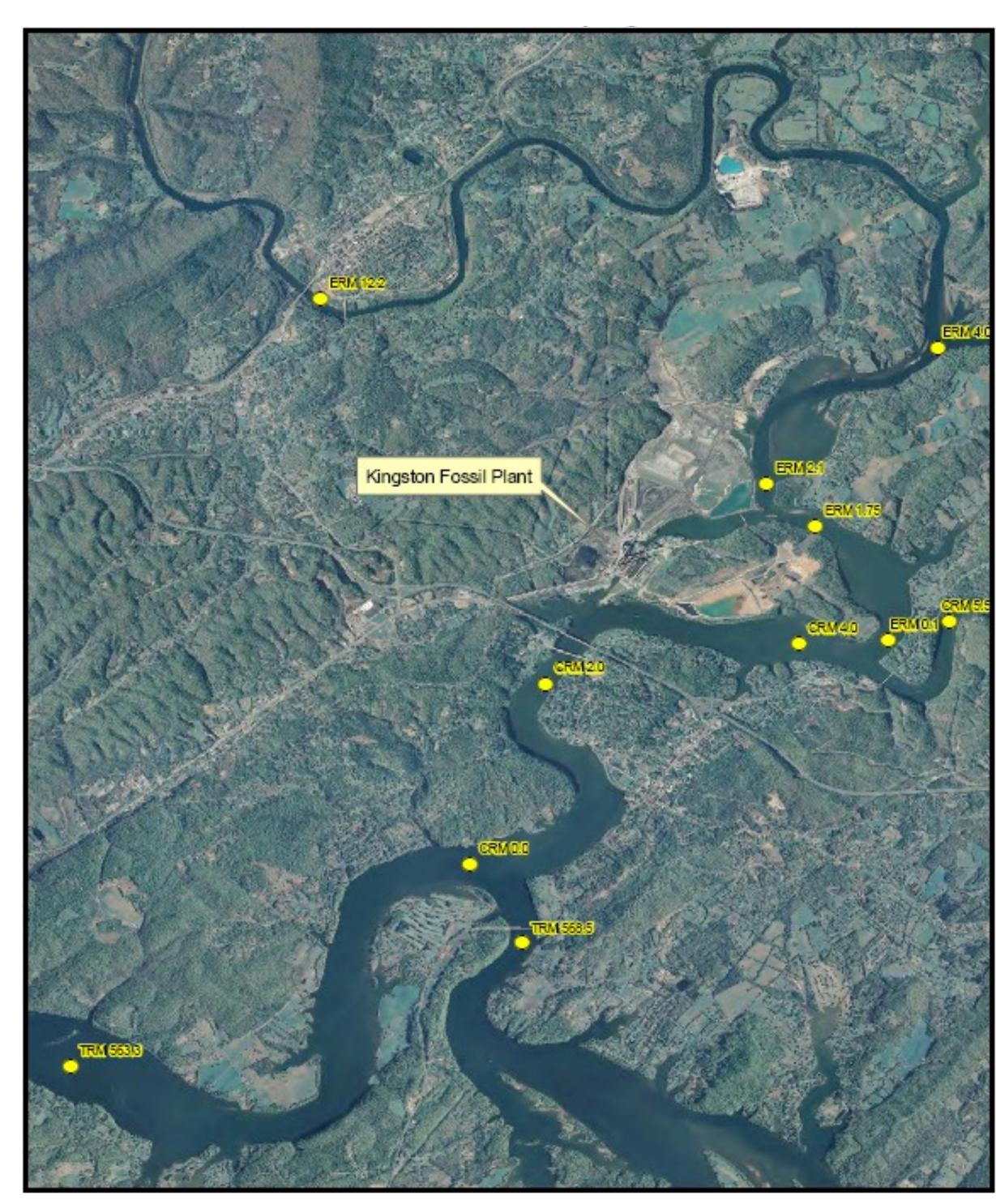
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Abstract

In response to the coal ash spill at the Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF), TVA, the Tennessee Department of Environment and Conservation (TDEC) and the Environmental Protection Agency (EPA) have collected surface water samples from the Emory, Clinch, and Tennessee Rivers. The objective of the surface water monitoring was to determine whether there was any immediate down-river migration of ashrelated constituents posing an imminent public health or environmental threat

Sampling was conducted at five Emory River, four Clinch River, and two Tennessee River locations. TVA sampled these locations two days per week and analyzed the samples for a 24 total and dissolved metals and total suspended solids. To monitor the effectiveness of best management practices to reduce ash migration during dredging, TVA performed daily monitoring of dredge plumes in the Emory River. TVA has collected more than 2,500 surface water samples since the spill.

During the time-critical removal action, total arsenic in four Emory River surface water samples exceeded its Tennessee Domestic Water Supply Standard (TDWS) and Tennessee Water Quality Criterion (TWQC) of 0.01 mg/L. Dissolved copper exceeded the fish and aquatic life criterion in one sample at ERM 1.75. Total lead exceeded its TDWS in two Emory River samples at ERM 1.75. Thallium was detected in 64 samples, all of which exceeded its TWQC. This poster summarizes the results of TVA water quality monitoring a KIF during the period in which dredging of ash from the river was occurring.



Routine Surface Water Sampling Locations. Image taken April 11 – 12, 2010.

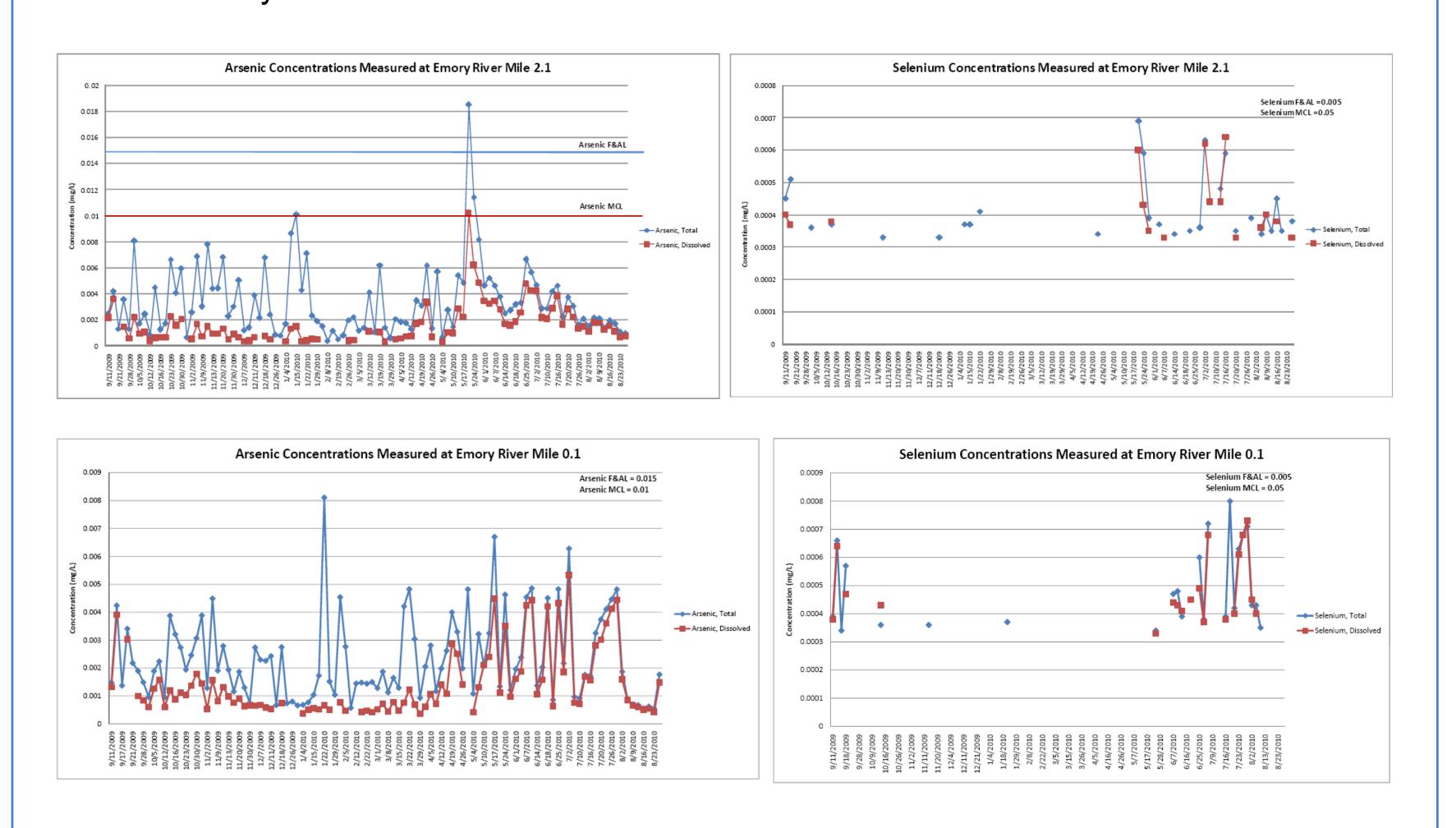
Data Overview

Data presented in this poster cover the time period 09/11/2009 through 08/27/2010. This period was selected because it coincides with the beginning of MDL reporting for analytical results and the completion of the time-critical response action. The MDL as defined by 40 CFR Part 136, Appendix B does not take into account any instrument blank or background effects and may in reality be much lower than is actually achievable. In addition, laboratories only determine the MDL on an annual basis and instrument maintenance issues may change the achievable MDL mid-year. Consequently, at the start of the project, TVA preferred the RL as a more defensible number for reporting. In comparing data sets from different regulatory bodies (EPA and State), it was found that other laboratories utilized the MDL as the limit on data reports. Consequently, to provide better data comparability TVA requested an achievable "project MDL" (pMDL) from its providing laboratories and moved away from RL reporting.

Emory River

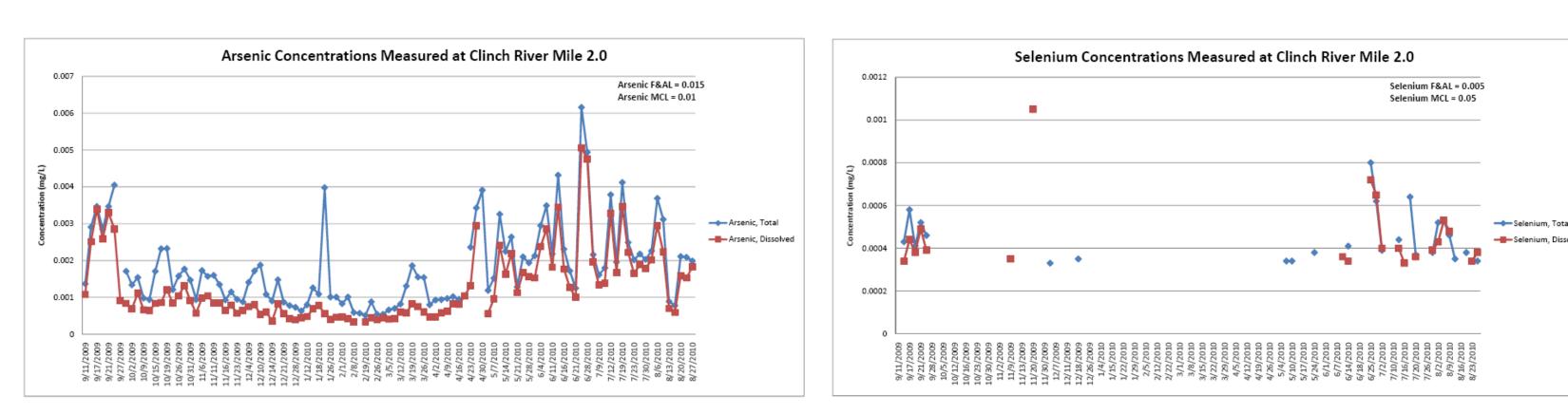
Surface water analytical results are compared to the Tennessee Water Quality Criteria for Recreation (TWQC), Domestic Water Supply (TDWS), and Fish and Aquatic Life (F&AL) use classifications as a reference for the potential significance of the data since the Emory, Clinch, and Tennessee Rivers are classified for those stream uses. However, closure of the most impacted reach of the Emory River during the ash recovery operation must be considered in these comparisons.

TVA data reported four exceedences of the TDWS and TWQC of 0.01 mg/L for total arsenic in Emory River surface water samples. These exceedences were in the vicinity of the ash spill at ERM 2.1 and ERM 1.75. Dissolved copper exceeded the F&AL in one sample at ERM 1.75. Lead exceeded its Tennessee Domestic Water Supply Criterion in one Emory River sample at ERM 1.75. Thallium was detected in 83 samples all of which exceed the TWQC. The graphs below present the arsenic and selenium results for surface water samples collected at ERM 2.1 and ERM 0.1. These locations were selected because they represent a location in the river impacted by the ash and the lower most sampling location before the Emory River meets the Clinch River.



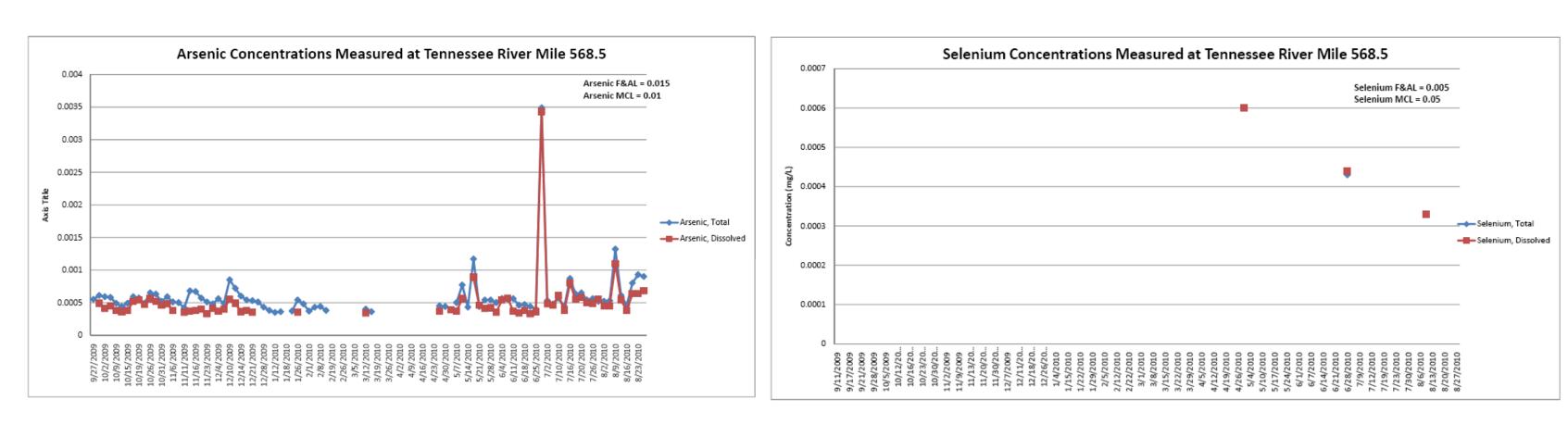
Clinch River

TVA data reported no exceedences of the TDWS and TWQC for arsenic in samples collected from the Clinch River. Total and dissolved mercury have been reported to exceed the TWQC in 3 and 1 Clinch River surface water samples, respectively. Thallium was detected in 29 samples all of which exceed the TWQC. The graphs below present the arsenic and selenium results for surface water samples collected at CRM 2.0.



Tennessee River

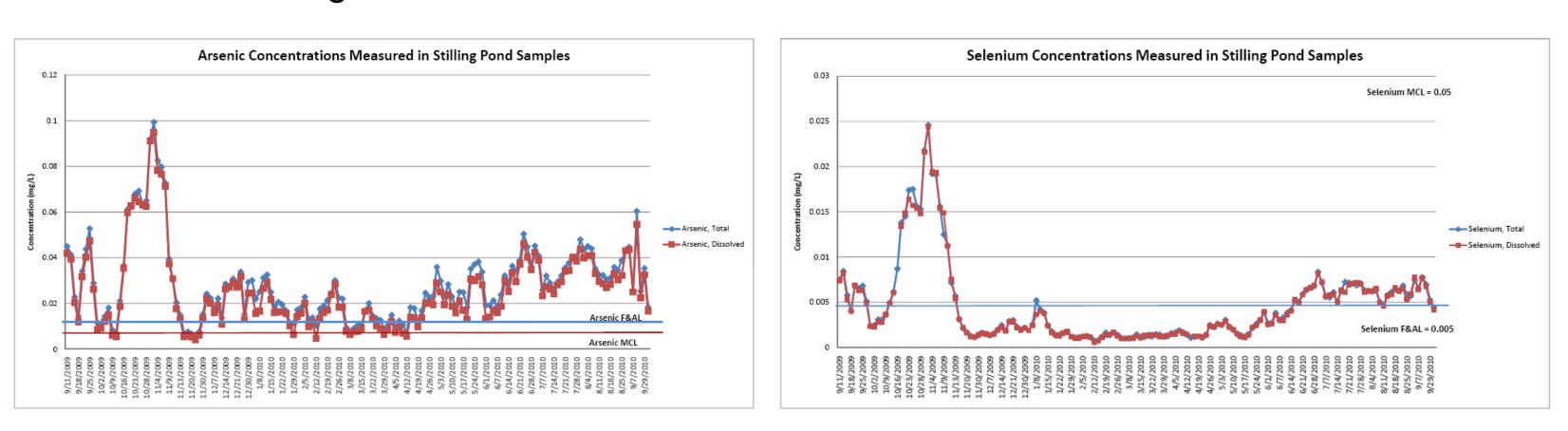
TVA data reported a single exceedence of the TDWS and TWQC for arsenic in samples collected from the Tennessee River. Total and dissolved mercury have been reported to exceed the TWQC in two separate Tennessee River surface water samples. Thallium was detected in one sample which exceeds the TWQC. The graphs below present the arsenic and selenium results for surface water samples collected at TRM 568.5.



Stilling Pond

Concurrent with the beginning of the pilot phase of dredging, on March 23, 2009, TVA began sampling the NPDES permitted outfall, KIF 001, daily to track effects of dredging so appropriate controls could be instituted to ensure continuing compliance with NPDES permit limits. KIF 001 is the final point of discharge for water from plant operations as well as dredging operations. The Stilling Pond is the final solids settling location in the ash recovery system.

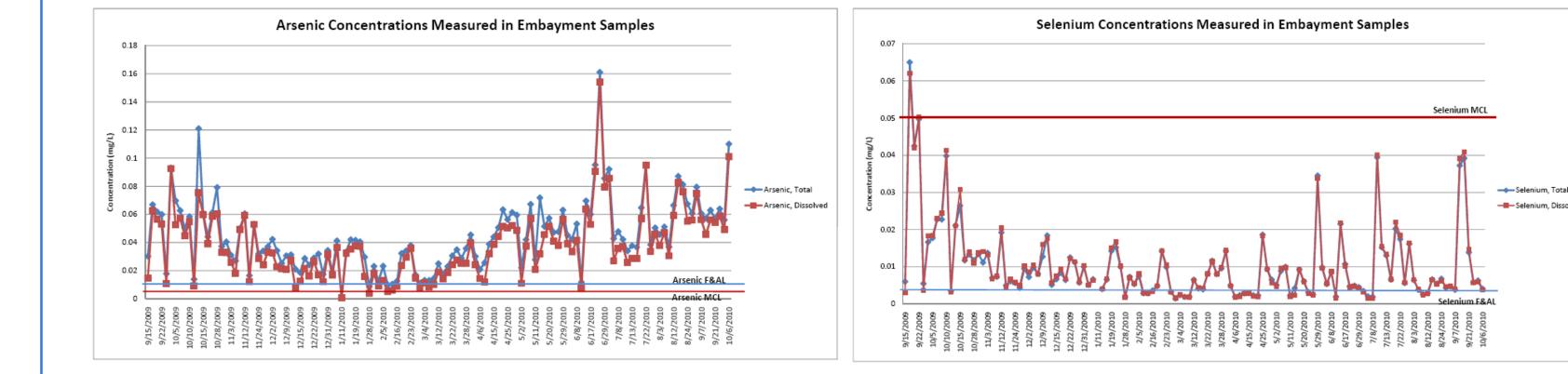
TVA data reported 238 exceedences of the TDWS and TWQC for arsenic in samples collected from the Stilling Pond. Antimony exceeded the TDWS and the TWQC in three samples. Total and dissolved mercury exceeded the TWQC in one and three samples, respectively. Selenium exceeded the F&AL in 114 samples. Total and dissolved thallium were detected in 90 and 103 samples, respectively, all detected concentrations exceed the TWQC. The graphs below present the arsenic and selenium results for surface water samples collected at the Stilling Pond outfall.



Swan Pond Embayment

Surface water sampling was conducted in the Swan Pond Embayment to evaluate the quality and flow of the water entering the Emory River from the Swan Pond Embayment following the spill. Samples are taken routinely from two stations: the discharge from the settling basins and the clean water ditch just downstream of the settling basin discharge. Sampling of surface water began on July 7, 2009. After 2 weeks of daily sample collection, sampling was reduced to two times a week and after a storm event of more than 0.5-inch rainfall in 24 hours.

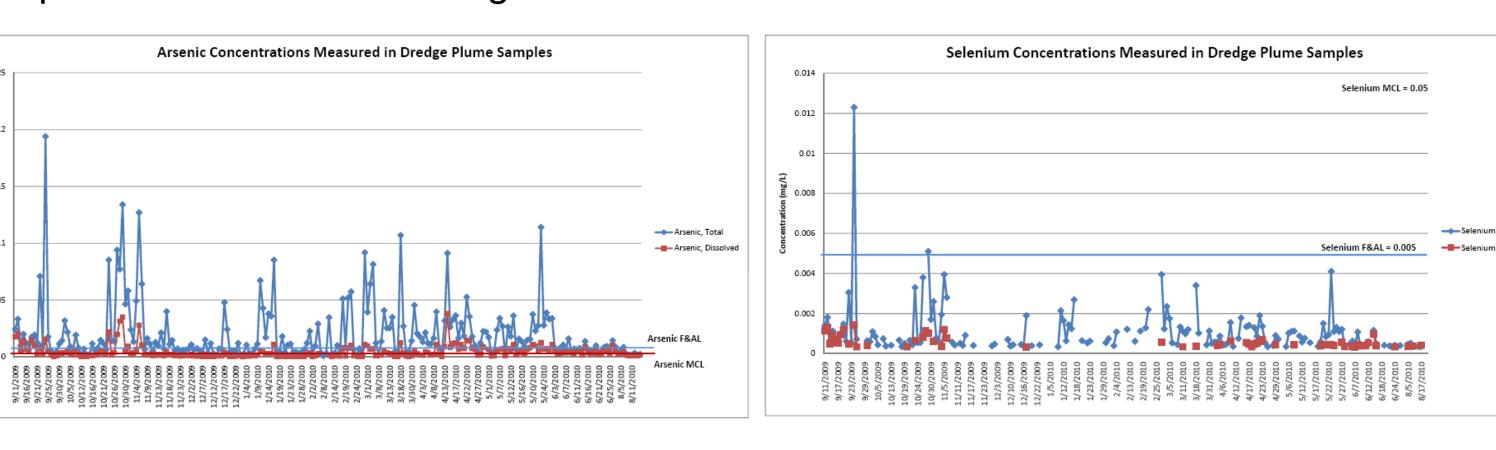
TVA data reported 92 and 149 exceedences of the TDWS and TWQC for arsenic in samples collected from the Clean Water Ditch and Settling Basin, respectively. Antimony exceeded the TDWS and the TWQC in 21 and 25 Settling Basin samples and two Clean Water Ditch samples. Lead exceeded the TDWS in 31 Settling Basin samples and two Clean Water Ditch samples. Total mercury exceeded the TWQC in one sample from the Settling Basin. Selenium exceeded the F&AL in 99 Settling Basin samples and 43 Clean Water Ditch Samples. Total and dissolved thallium were detected in 29 and 21 Clean Water Ditch samples, respectively. Total and dissolved thallium were detected in 104 and 66 Settling Basin samples, respectively. All detected thallium concentrations exceed the TWQC. It should be noted that the maximum concentrations of most constituents have been reported for samples from the settling basin discharge, prior to mixing with the clean water ditch. The graphs below present the arsenic and selenium results for surface water samples collected at the Embayment.



Emory River Dredge Plume

Dredge plume samples collected during the Phase 1 Emory River dredging operations had one or more concentrations of arsenic, mercury, selenium, or thallium exceed the domestic water supply criteria. These samples were obtained by first identifying the most turbid part of a visual dredge plume via Hydrolab® measurements, then collecting the samples from that location within the plume.

TVA data reported 147 exceedences of the TDWS and TWQC for arsenic in samples collected from the dredge plumes. Antimony exceeded the TDWS in a single sample and the TWQC in two samples. Beryllium exceeded the TDWS in 14 samples. Dissolved copper exceeded the F&AL in a single sample. Lead exceeded the TDWS in 115 samples. Dissolved mercury exceeded the TWQC in three samples. Nickel exceeded the TDWS in a single sample. Selenium exceeded the F&AL in two samples. Thallium exceeded the TDWS in seven samples and the TWQC in 109 samples. Comparison of the graphs for Dredge Plume and other Emory River samples indicates that even during dredging activities, ash related constituents settle out of the water column or are rapidly diluted. The graphs below present the arsenic and selenium results for surface water samples collected in the Dredge Plume.



Storm Flow

Additional sampling and analysis was triggered by either of the following two events: Predicted Emory River flow of >5,000 cubic feet per second (cfs) measured at the United States Geological Survey station at Oakdale, TN or rainfall >1.0" in a 24-hour period as measured at the KIF on-site meteorological station.

Comparison of arsenic concentrations at ERM 2.1 compared to Emory River flow (graph) demonstrates that arsenic concentrations do not increase with increased flow. However, comparison of total suspended solids (TSS) concentrations at ERM 2.1 compared to flow (graph) demonstrates that TSS concentrations do increase with increased flow suggesting a potential increased flux of ash-related constituents. Similar comparisons of arsenic and TSS concentrations measured in the Embayment with rainfall measured at the KIF meteorological station (graphs) demonstrate increases in both arsenic and TSS with rainfall suggesting an increased flux of ash related constituents from released ash remaining on land to the Embayment.

